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FREE-RECALL LEARNING AT DIFFERENT GRADE LEVELS. FINAL REPORT.

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THE VERBAL BEHAVIOR OF CHILDREN FROM FOUR GRADE LEVELS (10, EIGHT, SIX, AND FOUR) WAS INVESTIGATED BY HAVING EACH SUBJECT (S) LEARN TO FREE-RECALL THREE 20-WORD LISTS OF UNRELATED WORDS. A MULTITRIAL PROCEDURE WAS USED IN WHICH SS EXPERIENCED 10 CONSECUTIVE LEARNING AND TEST TRIALS ON EACH LIST. TWO MEASURES WERE USED TO ANALYZE BOTH INTRALIST AND INTERLIST CHANGES IN THE DATA. THESE WERE "FREE-RECALL LEARNING," THE NUMBER OF CORRECT WORDS PER TEST TRIAL WITHOUT RESPECT TO ORDER OF RECALL, AND "SUBJECTIVE ORGANIZATION," DESIGNED FOR ANALYZING CHANGES IN THE ORGANIZATION OF RECALLED WORDS DURING FREE-RECALL LEARNING. AN INCREASE IN BOTH SUBJECTIVE ORGANIZATION AND FREE-RECALL SCORES AS A FUNCTION OF INTRALIST PRACTICE WERE FOUND. IN THE CASE OF INTERLIST PRACTICE, THE SUBJECTIVE ORGANIZATION SCORES INCREASED OVER LISTS PRACTICED, WHILE LIST-LEARNING DECREASED. POSITIVE CORRELATIONS WERE OBTAINED BETWEEN SUBJECTIVE ORGANIZATION AND FREE-RECALL SCORES IN THE CASE OF THE HIGHER GRADE LEVELS, 10 AND EIGHT, WHILE NEGATIVE CORRELATIONS WERE FOUND IN THE LOWER GRADES, SIX AND FOUR. BOTH SUBJECTIVE ORGANIZATION AND FREE-RECALL SCORES INCREASED AS A FUNCTION OF HIGHER GRADE LEVELS. THE RESULTS WERE COMPARED WITH THE FINDINGS OBTAINED FROM SIMILAR STUDIES INVESTIGATING FREE-RECALL LEARNING IN YOUNG ADULTS. (AUTHOR)

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Free-recall learning at different grade levels

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SUMMARY

The verbal behavior of children from four grade levels, ten, eight, six, and four, was investigated by having each S learn to free-recall three, 20-word lists of unrelated words. A multi-trial procedure was used in which S experienced ten consecutive learning and test trials on each list. Two measures were used to analyze both intralist and interlist changes in the data. These were "free-recall learning", the number of correct words per test trial without respect to order of recall, and "subjective organization", designed for analyzing changes in the organization of recalled words during free-recall learning.

An increase in both subjective organization and free-recall scores as a function of intralist practice were found. In the case of interlist practice, the subjective organization scores increased over lists practiced, while list-learning decreased. Positive correlations were obtained between subjective organization and free-recall scores in the case of the higher grade levels, ten, and eight, while negative correlations were found in the lower grades, six and four. Both subjective organization and free-recall scores increased as a function of higher grade levels.

The results were compared with the findings obtained from similar studies investigating free-recall learning in young adults.

INTRODUCTION

Free-recall learning is probably a most basic means of learning in children and adults but, to date, the traditional procedure used in exploring age developmental changes in learning and retention is the method of paired-associates (Keppel, 1964). A methodological advantage to be gained by using the method of free-recall, instead of serial or paired-associates learning, is that since greater flexibility is afforded S in recalling verbal materials to be learned, this makes it easier to discover the manner in which S transforms the stimulus-input, organizes the materials in memory, and retrieves the information (Mandler, 1966). Thus, studying free-recall learning at different ages could disclose some important development changes in the processing of verbal information.

The verbal behavior of young adults (college sophomores) has been investigated using the multi-trial, free-recall procedure with related words as stimulus materials (Tulving, 1962). The advantage for using unrelated words with the multi-trial procedure is that this method makes it easy to observe and measure progressive changes in S's idiosyncratic organizing of the stimulus-list and, to the traditional measure of learning, number of correct words per test trial (C), Tulving (1962) has added a measure, "subjective organization," designed for analyzing changes in the organization of recalled words during free-recall learning. Sub-

jective organization (SO) is defined as S's tendency to recall words in the same order on different test trials in the absence of any experimentally manipulated organization among words in the stimulus list. Several studies have concluded that free-recall learning is related to S's ability to organize the verbal materials being learned during recall. It has been shown that the magnitude of both subjective organization and learning increase concomitantly with practice, as a function of trials (Tulving, 1962) and over lists practiced (Mayhew, 1967; Tulving, McNulty, and Ozier, 1965). Also, there exists a high positive correlation between the two variables (Mayhew, 1967; Tulving, 1962, 1964) indicating that those Ss who achieve high subjective organization scores recall more words than Ss with low organization scores.

The purpose of this study was to observe whether the positive relationship between subjective organization and learning, found above in young adults, (college sophomores), exists in children of different ages. Children from four grade levels were sampled, the grades four, six, eight, and ten. Grade ten was chosen as an upper limit, since there is evidence that high school students and young adults do not differ in verbal performance (e.g., Jenkins, 1964; Palermo, 1963). Grade four was chosen as the lower limit to insure linguistic skills were well developed.

METHOD

Experimental design: Within each of four grade levels, each S learned three different lists of words by the method of free recall learning. During the learning of each list of 20 unrelated words, S experienced ten learning trials alternated by ten test trials.

The experimental design is a three-factor experiement, 4 x (10 x 3) with repeated measures on the last two factors. The first factor is the independent main effect of grade levels, and the last are the main effects of intra- and interlist practice effect, respectively.

Materials: The learning material were disyllabic, English nouns taken from the Thorndike-Lorge (1944) word book, and occurring at least 100 per million words in frequency count. This lower limit is well within the lowest recommended frequency count by Thorndike-Lorge for fourth grade children, thereby insuring high familiarity of stimulus-materials for all grade levels. These words were used to construct three, 20-word lists. In constructing these lists the words were selected so that each list contains words (a) approximately distributed among all frequency-of-occurence categories and (b) with rough alphabetical distribution of the first letter of words, and (c) with no two words beginning with the same letter of the alphabet.

Thirty-five millimeter Kodak slides were made from these words. Each set of 20 slides comprising an experimental list, was

placed in a separate universal slide tray.

Subjects: A total of forty-four students of both male and female sex were selected from the local elementary and high schools of Burlington, Vermont; twelve from grade levels, twelve and eight, and eleven from grade levels, six and four. The three experimental lists were counterbalanced in order of presentation to form three orders thus giving three counterbalanced list orders for each grade. There were initially 12 Ss in each grade equally divided within the three counterbalanced orders. However, when the recall booklets were being prepared for data analysis, it was apparent that one S in each of the grade levels, six and four, misunderstood the procedure. These data were discarded resulting in 11 Ss in those grades.

Procedure: Prior to the experiment, each of the five Ss in a group received three booklets, each booklet containing a set of ten blank recording slips stapled together.

The instructions were given to all Ss before the first trial informing them that their task was to memorize a list of 20 nouns, which would be projected one by one on the screen in front of the room. After all 20 words were shown, they were to record as many as possible on the first recording slip, with no restrictions in the order in which they recorded the words. When time was called by E they were to turn the page of the booklet to a new blank sheet. They would then receive a second learning trial followed by another test period, and so on for ten alternating learning and test trials. Following this they would learn, in the same manner, a second and third list of different words.

The words were projected by a Kodak Carousel 800 projector, at the rate of approximately 1.5 sec. per word. The S's had 120 sec. after each learning trial to record their recalled words. This test interval was of long enough duration to ensure that S were not rushed during the test phase. The order of the stimulus words were changed after each trial in a non-systematic manner. This was performed by haphazardly rearranging the slides in the slide tray during the test interval. Ten seconds elapsed between the end of a test period and the beginning of a learning trial. Sixty seconds elapsed between the last test period of one list and first test period of a new list.

RESULTS AND FINDINGS

For each recall test of each S, the number of correctly recalled words was determined without respect to order in recall. Intralist and interlist scores on the measures, subjective organization (SO, lag 0, described by Tulving, 1962) and list-learning (C), were calculated on an 1130 IBM computer using programs developed by Tulving. The results are discussed below under headings intralist and interlist scores.

Intralist scores: On each list, each S has ten intralist C scores. Intralist SO scores were calculated from successive pairs of test trials, resulting in each S having five SO scores per list. Analyses of variance were carried out on the scores of each of the measures over grade lists and trials. Within each grade level the three lists were combined for analyses. Displayed in Table 1 are intralist scores for each of the measures, by grade level and test trial. Each number represents a mean score for Ss within a particular grade level. For easy comparison of changes between the measures SO and C over trials, successive pairs of intralist C scores are averaged together on the table. An overall mean score for each grade level is provided by averaging the scores of each measure over trials.

The analysis of variance on the data shows a significant rise in intralist SO scores over trial blocks ($F = 6.203$; $df = 4,536$; $p < .01$) and a significant age group difference ($F = 3.333$; $df = 3,134$; $p < .05$) with greater SO score accompanying higher grades. No significant interaction ($F = 2.008$NS; $df = 12,536$) between grades and trial blocks is demonstrated.

The rise in intralist C scores over trial blocks is significant ($F = 219.432$; $df = 9,1206$; $p < .01$). The age group difference is significant $F = 110.321$, $df = 3,134$; $p < .01$) with greater C scores accompanying higher grades. A significant interaction between grades and trial blocks ($F = 12.611$; $df = 27,1206$; $p < .01$) is demonstrated. The interaction between grades and trials for interlist C scores is accounted by the observed fact that the rise in scores over trials is less pronounced in the lower grade levels (six and four) than in the high grade levels (ten and eight). Analysis of the intralist C scores by the Kramer (1956) multiple range test shows that the data resolve themselves into two relatively discrete clusters: Homogeneity between grades ten and eight, and homogeneity between grades six and four.

Interlist scores: Each S learned three lists of words. Consequently, each S has three interlist SO and C scores. Each interlist C score was calculated by averaging the intralist C scores over the block of ten test trials per list. Each interlist SO score was computed over the block of test trials per list (Tulving, 1962). Analysis of variance were carried out on the scores of each of the measures over grade levels and experimental lists. Displayed in Table 11 are interlist scores for each of the measures, by grade level and experimental list. Each number represents a mean score for Ss within a particular grade level. An overall mean score for each grade level is provided by averaging the scores of each measure over experimental lists.

The analysis of variance on the data shows a significant rise in interlist SO scores over lists ($F = 37.060$; $df = 2,84$; $p < .01$). However, the tendency for larger SO scores to accompany higher grades is not significant ($F = 1.090$NS; $df = 3,42$). There is no significant interaction ($F = 1.492$NS; $df = 6,84$) between grades and lists.

TABLE 1

Mean Intralist Scores on the Measures as a Function of Test Trials and Grades

GRADES	TRIALS (B1.2)	MEASURES SO	C
10	1-2	.16	12.1
	3-4	.24	16.5
	5-6	.27	17.5
	7-8	.34	18.5
	9-10	.41	18.8
	$\bar{X}$	.28	16.7
8	1-2	.16	9.3
	3-4	.29	13.5
	5-6	.27	15.2
	7-8	.28	15.6
	9-10	.29	16.3
	$\bar{X}$	.26	14.0
6	1-2	.14	6.1
	3-4	.17	8.3
	5-6	.20	9.1
	7-8	.22	8.9
	9-10	.18	9.9
	$\bar{X}$	.18	8.4
4	1-2	.19	4.5
	3-4	.13	6.0
	5-6	.20	6.4
	7-8	.19	6.8
	9-10	.19	7.0
	$\bar{X}$	.18	6.1

NOTE: Scores are means based on N = 12 per cell for grades 10 and 8 and N = 11 per cell per grades 6 and 4.

$\bar{X}$ refers to an overall mean score calculated over trials.

TABLE 11

Mean Interlist Scores on the Measures and Correlations Between Subjective Organization and List-Learning Scores as a Function of Experimental Lists and Grades

GRADES	LISTS	MEASURES SO	C	SO:C
10	1	.25	15.9	+.37
	2	.35	17.0	+.46
	3	.46	17.1	+.49
	$\bar{X}$	.35	16.6	
8	1	.26	14.0	+.58*
	2	.34	14.5	+.62*
	3	.34	13.5	+.54*
	$\bar{X}$	.31	14.0	
6	1	.20	9.6	.55*
	2	.29	9.2	.74**
	3	.33	6.5	.68*
	$\bar{X}$	.27	8.4	
4	1	.18	7.5	.60*
	2	.26	6.1	.23
	3	.31	4.8	.75**
	$\bar{X}$	.25	6.1	

NOTE: Scores are means based on N = 12 per cell for grades 10 and 8 and N = 11 per cell for grades 6 and 4.

$\bar{X}$ refers to an overall mean score calculated over lists.

The rise in interlist C scores over grade levels is significant ($F = 42.587$; $df = 3,42$; $p < .01$) with greater C scores accompanying higher grades. However, the significant change in interlist C scores over list ($F = 16.482$; $df = 2,84$; $p < .01$) denotes a decrease in C scores over lists learned. A significant interaction between grades and lists ($F = 9.293$; $df = 6,84$; $p < .01$) demonstrates that the lower the grade level the greater the tendency for there to be a decrease in interlist C scores over the experimental lists. This was especially evident in the grades (six and four), whereas in grade ten there was a slight increase in scores over lists. Analysis of the interlist C scores by the Kramer (1956) multiple range test shows that the data resolve themselves into two relatively discrete clusters: Homogeneity between grades ten and eight and homogeneity between grades six and four.

The decrease in interlist C scores over lists learned in the lower grade levels (six and four) is probably accounted for by the fact that the experimental procedure lasted for more than an hour, and the younger Ss from the lower grades became bored and tired after practicing the first experimental list. Subject fatigue is reflected also in the significant deviation on both the intralist and interlist C scores of the lower grades from the older grades. On the other hand, a similar relationship was not found in the case of the SO scores since many Ss decreased C scores over lists, but while repeating a diminishing subset of words from the stimulus-list, they repeated them in approximately the same order on each test trial, which resulted in a consistently high SO score over all three lists. Inspection of the recall sheets of Ss substantiates that this strategy was used by many Ss in grades six and four.

Within each grade level, a product-moment correlation was computed between interlist SO and C scores for each experimental list. The correlations are displayed in Table 11. In grades ten and eight the correlations are positive and significant in the case of grade eight and not grade ten. Among young adults several investigators (Mayhew, 1967; Tulving, 1962, 1964) have found high positive and very significant correlations between SO and C scores, (correlations in the range of +.90). Therefore, the relationship between the subjective organization scores and list-learning, while positively related in the case of grades ten and eight, is not as striking as it is in young adults. In the case of grades six and four, the correlations were nearly all significant and negative. However, the fact that many Ss in these lower grades decreased their interlist C scores over lists, while continuing to maintain high interlist SO scores, would account for the negative correlation. Therefore, this finding seems to be derived partly from the long experimental procedure being particularly tiresome for Ss in the lower grades.

CONCLUSIONS

The study demonstrates that the increase in both subjective organization and recall scores as a function of practice, found in young adults learning to free-recall a list of words (Tulving, 1962), exists in children of different grades, ten, eight, six, and four. However, a similar increase in these measures over lists practiced, found in young adults (Mayhew, 1967; Tulving, McNulty, and Ozier, 1965), was not shown in this study. Specifically, the subjective organization scores increased over lists practiced while the list-learning decreased. This was evident especially in the youngest grades, six and four, where list-learning scores decreased greatly over the three lists. Further analysis of the results suggests that the learning task was too difficult and the experimental procedure too time-consuming for many Ss in the younger grades to concentrate beyond the first list.

The high positive and significant correlations between subjective organization and recall scores in young adults (Mayhew, 1967; Tulving, 1962; 1964) was partially found at the higher grades levels, ten and eight, although the correlations were not as high as previously shown. However, in the younger grades, six and four, there was a highly significant negative correlation between subjective organization and recall scores. This is partially accounted for the procedural artifact discussed above.

It was observed that both subjective organization and recall scores over practice trials and lists increased with higher grade levels. However, the recall scores in the higher grade levels and lower grade levels formed two relatively discrete clusters.

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822